

<b>L Number</b>	<b>Hits</b>	<b>Search Text</b>	<b>DB</b>	<b>Time stamp</b>
<b>1</b>	<b>0</b>	<b>((magnetic adj recording) and layer and (magnetic adj domain) and laser ) and ((reproducing or read or reading or playback) adj layer)) and (calibration or calibrating)</b>	<b>USPAT; EPO; JPO</b>	<b>2004/04/28 14:30</b>
<b>2</b>	<b>465</b>	<b>(magnetic adj recording) and layer and (magnetic adj domain) and laser</b>	<b>USPAT; EPO; JPO</b>	<b>2004/04/28 14:32</b>
<b>4</b>	<b>80</b>	<b>((magnetic adj recording) and layer and (magnetic adj domain) and laser ) and ((reproducing or read or reading or playback) adj layer)</b>	<b>USPAT; EPO; JPO</b>	<b>2004/04/28 14:34</b>
<b>5</b>	<b>5</b>	<b>((magnetic adj recording) and layer and (magnetic adj domain) and laser ) and ((reproducing or read or reading or playback) adj layer)) and (calibration or calibrating)</b>	<b>USPAT; EPO; JPO</b>	<b>2004/04/28 14:35</b>



US006307819B1

(12) **United States Patent**  
Birukawa et al.

(10) Patent No.: **US 6,307,819 B1**  
(45) Date of Patent: **Oct. 23, 2001**

(54) **METHOD OF READING MAGNETO-OPTICAL RECORDING MEDIUM**

(75) Inventors: Masahiro Birukawa, Osaka; Yasumori Hino, Nara; Norio Miyatake, Hyogo, all of (JP)

(73) Assignee: Matsushita Electric Industrial Co., Ltd., Osaka (JP)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/420,685

(22) Filed: Oct. 19, 1999

**Related U.S. Application Data**

(62) Division of application No. 08/883,549, filed on Jun. 26, 1997, now Pat. No. 5,986,977.

(30) **Foreign Application Priority Data**

Jun. 28, 1996 (JP) ..... 8-170214

(51) Int. Cl.<sup>7</sup> ..... G11B 11/00

(52) U.S. Cl. .... 369/13; 428/694 ML

(58) Field of Search ..... 369/13, 14, 110.01, 369/116, 283; 428/694 MM, 694 MT, 694 ML, 694 EC, 694 RE, 900; 360/59, 114

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,020,041 5/1991 Nakao et al. .... 369/13  
5,241,520 8/1993 Ohta et al. .  
5,623,458 4/1997 Matsumoto et al. .

5,648,162 7/1997 Hirokane et al. .  
5,691,072 11/1997 Izumi et al. .  
5,691,963 11/1997 Hirokane et al. .  
5,706,259 1/1998 Fukamachi et al. .  
5,740,133 \* 4/1998 Tamao et al. .... 369/13  
5,862,105 1/1999 Nishimura .

**FOREIGN PATENT DOCUMENTS**

3-242845 10/1991 (JP) .  
8-17090 1/1996 (JP) .  
8-7383 1/1996 (JP) .

\* cited by examiner

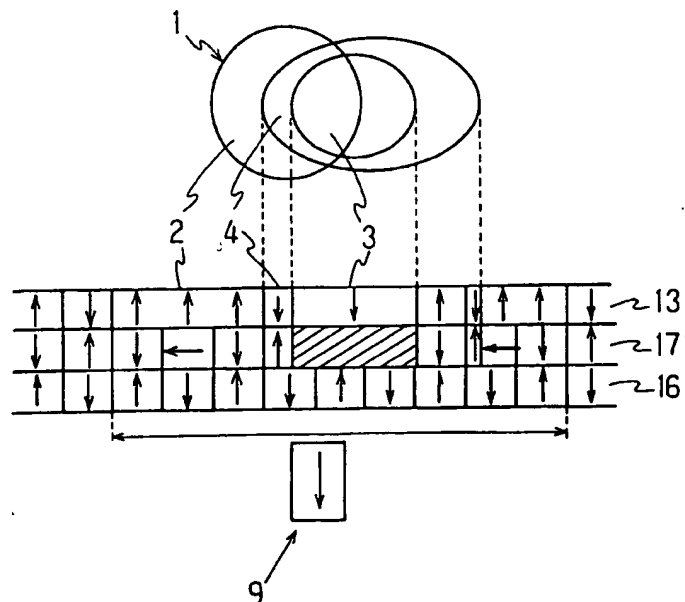
Primary Examiner—Ali Neyzari

(74) Attorney, Agent, or Firm—Merchant & Gould PC

(57) **ABSTRACT**

A reading method for a magneto-optical recording medium is provided, irradiating laser light as a reading beam and using a magnetic head. High density and high transmission rate are possible and a correct reading can be performed according to the length of recording marks by reading the magneto-optical recording medium while impressing a magnetic field with an orientation promoting the translation of magnetic domain walls. In the magnetic super resolution type magneto-optical recording medium, which attains a signal only from one portion of the irradiation domain of the reading beam and has at least a recording layer and a reading layer on a substrate, the focused laser light is irradiated as a reading beam and the magnetic field is modulated, using the magnetic head, which is equipped with a slider and glides or floats on the recording medium. The magneto-optical recording medium is read, while impressing a magnetic field 161 that accelerates at least the transcription of the magnetization of the recording layer into the reading layer.

2 Claims, 18 Drawing Sheets





US006269056B1

(12) **United States Patent**  
Birukawa et al.

(10) Patent No.: **US 6,269,056 B1**  
(45) Date of Patent: **\*Jul. 31, 2001**

(54) **RECORDING METHOD FOR A  
MAGNETO-OPTICAL RECORDING  
MEDIUM FOR POSITION ADJUSTMENT OF  
A MAGNETIC HEAD**

(75) Inventors: Masahiro Birukawa, Osaka; Yasumori  
Hino, Nara; Norio Miyatake, Hyogo,  
all of (JP)

(73) Assignee: **Matsushita Electric Industrial Co.,  
Ltd., Osaka (JP)**

(\*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/421,785

(22) Filed: **Oct. 19, 1999**

#### Related U.S. Application Data

(62) Division of application No. 08/883,549, filed on Jun. 26, 1997, now Pat. No. 5,986,977.

#### (30) Foreign Application Priority Data

Jun. 28, 1996 (JP) ..... 8-170214

(51) Int. Cl.<sup>7</sup> ..... G11B 11/00

(52) U.S. Cl. .... 369/13; 369/116

(58) Field of Search ..... 369/13, 116, 275.2,  
369/14, 110, 275.3, 288; 429/694 EC, 694 ML,  
694 MM; 360/59, 114, 77.04, 51

#### (56) References Cited

##### U.S. PATENT DOCUMENTS

5,020,041 5/1991 Nakao et al. .

5,241,520	8/1993	Ohto et al. ....	369/13
5,623,458	4/1997	Matsumoto et al. ....	369/13
5,648,162	* 7/1997	Hirokane et al. ....	428/332
5,691,072	11/1997	Izumi et al. ....	428/694 ML
5,691,963	* 11/1997	Hirokane et al. ....	369/13
5,706,259	1/1998	Fukamachi et al. ....	369/13
5,740,133	4/1998	Tamanai et al. .	
5,862,105	1/1999	Nishimura .....	369/13

#### FOREIGN PATENT DOCUMENTS

3-242845	10/1991	(JP) .
8-17090	1/1996	(JP) .
8-7383	1/1996	(JP) .

\* cited by examiner

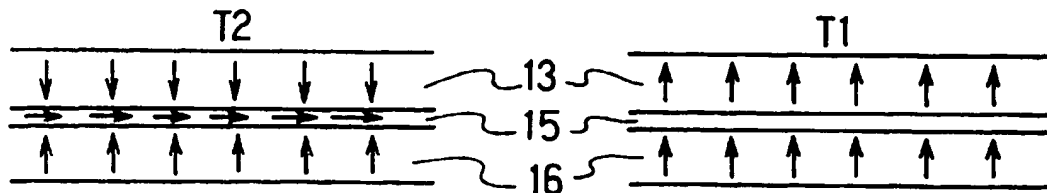
Primary Examiner—Ali Neyzari

(74) Attorney, Agent, or Firm—Merchant & Gould P.C.

#### (57) ABSTRACT

A reading method for a magneto-optical recording medium is provided, irradiating laser light as a reading beam and using a magnetic head. High density and high transmission rate are possible and a correct reading can be performed according to the length of recording marks by reading the magneto-optical recording medium while impressing a magnetic field with an orientation promoting the translation of magnetic domain walls. In the magnetic super resolution type magneto-optical recording medium, which attains a signal only from one portion of the irradiation domain of the reading beam and has at least a recording layer and a reading layer on a substrate, the focused laser light is irradiated as a reading beam and the magnetic field is modulated, using the magnetic head, which is equipped with a slider and glides or floats on the recording medium. The magneto-optical recording medium is read, while impressing a magnetic field 161 that accelerates at least the transcription of the magnetization of the recording layer into the reading layer.

2 Claims, 18 Drawing Sheets





US006222797B1

(12) **United States Patent**  
Birukawa et al.

(10) Patent No.: **US 6,222,797 B1**  
(45) Date of Patent: **Apr. 24, 2001**

(54) **POSITION ADJUSTMENT METHOD  
OF A MAGNETIC HEAD USING  
MAGNETO-OPTICAL RECORDING  
MEDIUM, AND OPTICAL RECORDING  
MEDIUM**

(75) Inventors: Masahiro Birukawa, Osaka; Yasumori  
Hino, Nara; Norio Miyatake, Hyogo,  
all of (JP)

(73) Assignee: Matsushita Electric Industrial Co.,  
Ltd., Osaka (JP)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/420,476

(22) Filed: Oct. 19, 1999

#### Related U.S. Application Data

(62) Division of application No. 08/883,549, filed on Jun. 26,  
1997, now Pat. No. 5,986,977.

#### (30) Foreign Application Priority Data

Jun. 28, 1996 (JP) ..... 8-170214

(51) Int. Cl.<sup>7</sup> ..... G11B 11/00

(52) U.S. Cl. .... 369/13; 369/116; 428/694 EC

(58) Field of Search ..... 369/13, 116, 275.2,  
369/275.3, 288, 110, 14, 283; 428/694 EC,  
696 MM, 694 ML; 360/59, 114

#### (56) References Cited

##### U.S. PATENT DOCUMENTS

5,020,041 \* 5/1991 Nakao et al. .... 369/13  
5,241,520 8/1993 Ohta et al. .... 369/13

5,623,458 4/1997 Matsumoto et al. .... 369/13  
5,648,162 7/1997 Hirokane et al. .... 428/332  
5,691,072 11/1997 Izumi et al. .... 428/694 ML  
5,691,963 \* 11/1997 Hirokane et al. .... 369/13  
5,706,259 1/1998 Fukamachi et al. .... 369/13  
5,740,133 4/1998 Tamano et al. .... 369/13  
5,862,105 1/1999 Nishimura ..... 369/13

#### FOREIGN PATENT DOCUMENTS

3-242845 10/1991 (JP) .  
8-17090 1/1996 (JP) .  
8-7383 1/1996 (JP) .

\* cited by examiner

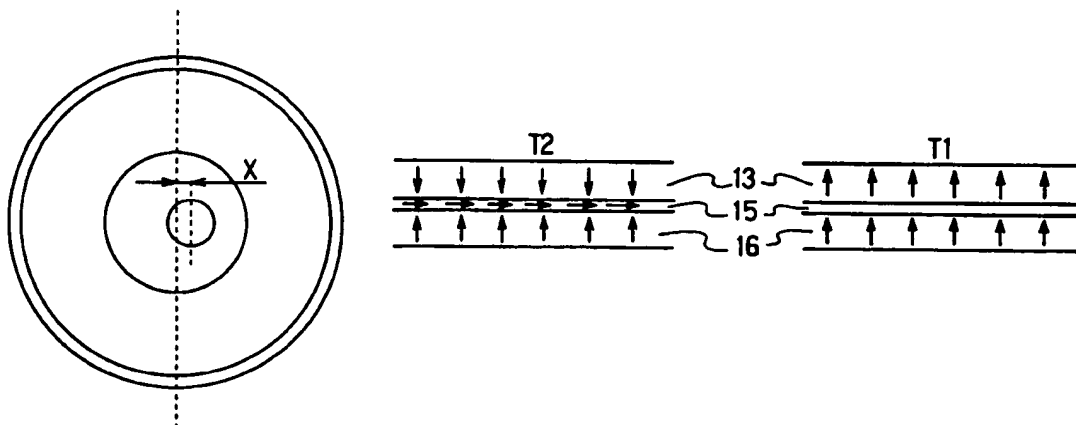
Primary Examiner—Ali Neyzari

(74) Attorney, Agent, or Firm—Merchant & Gould P.C.

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2 Claims, 18 Drawing Sheets





US006188649B1

(12) **United States Patent**  
Birukawa et al.

(10) Patent No.: **US 6,188,649 B1**  
(45) Date of Patent: **Feb. 13, 2001**

(54) **METHOD FOR READING MAGNETIC  
SUPER RESOLUTION TYPE  
MAGNETO-OPTICAL RECORDING  
MEDIUM**

(75) Inventors: Masahiro Birukawa, Osaka; Yasumori  
Hino, Nara; Norio Miyatake, Hyogo,  
all of (JP)

(73) Assignee: Matsushita Electric Industrial Co.,  
Ltd., Osaka (JP)

(\*) Notice: Under 35 U.S.C. 154(b), the term of this  
patent shall be extended for 0 days.

(21) Appl. No.: 09/420,686

(22) Filed: **Oct. 19, 1999**

#### Related U.S. Application Data

(62) Division of application No. 08/883,549, filed on Jun. 26,  
1997, now Pat. No. 5,986,977.

#### (30) Foreign Application Priority Data

Jun. 28, 1996 (JP) ..... 8-170214

(51) Int. Cl.<sup>7</sup> ..... **G11B 11/00**

(52) U.S. Cl. .... 369/13; 369/116; 429/694 EC

(58) Field of Search ..... 369/13, 116, 275.2,  
369/275.3, 110, 288, 283, 14; 429/694 EC,  
694 ML, 694 MM

#### (56) References Cited

##### U.S. PATENT DOCUMENTS

5,241,520 8/1993 Ohta et al. .... 369/13  
5,623,458 4/1997 Matsumoto et al. .... 369/13

5,648,162 \* 7/1997 Hirokane et al. .... 428/332  
5,691,072 \* 11/1997 Izumi et al. .... 428/694 ML  
5,691,963 \* 11/1997 Hirokane et al. .... 369/13  
5,706,259 1/1998 Fukamachi et al. .... 369/13  
5,862,105 1/1999 Nishimura ..... 369/13

#### FOREIGN PATENT DOCUMENTS

3-242845 10/1991 (JP) .  
8-17090 1/1996 (JP) .  
8-7383 1/1996 (JP) .

\* cited by examiner

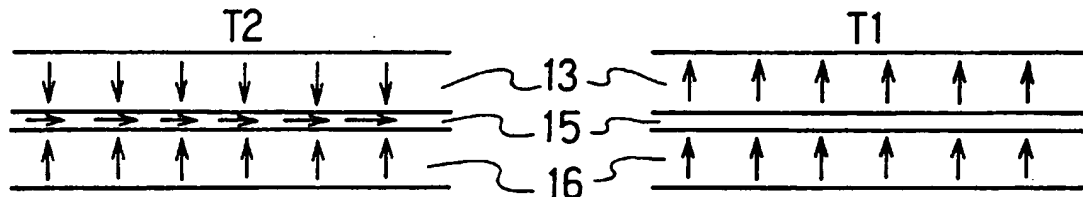
Primary Examiner—Ali Neyzari

(74) Attorney, Agent, or Firm—Merchant & Gould P.C.

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2 Claims, 18 Drawing Sheets





US006307819B1

(12) **United States Patent**  
Birukawa et al.

(10) Patent No.: **US 6,307,819 B1**  
(45) Date of Patent: **Oct. 23, 2001**

(54) **METHOD OF READING MAGNETO-OPTICAL RECORDING MEDIUM**

(75) Inventors: Masahiro Birukawa, Osaka; Yasumori Hino, Nara; Norio Miyatake, Hyogo, all of (JP)

(73) Assignee: Matsushita Electric Industrial Co., Ltd., Osaka (JP)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/420,685

(22) Filed: Oct. 19, 1999

**Related U.S. Application Data**

(62) Division of application No. 08/883,549, filed on Jun. 26, 1997, now Pat. No. 5,986,977.

(30) **Foreign Application Priority Data**

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(51) Int. Cl.<sup>7</sup> ..... G11B 11/00

(52) U.S. Cl. .... 369/13; 428/694 ML

(58) Field of Search ..... 369/13, 14, 110.01, 369/116, 283; 428/694 MM, 694 MT, 694 ML, 694 EC, 694 RE, 900; 360/59, 114

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5,020,041 5/1991 Nakao et al. .... 369/13  
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5,623,458 4/1997 Matsumoto et al. .

5,648,162 7/1997 Hirokane et al. .  
5,691,072 11/1997 Izumi et al. .  
5,691,963 11/1997 Hirokane et al. .  
5,706,259 1/1998 Fukamachi et al. .  
5,740,133 \* 4/1998 Tamanoi et al. .... 369/13  
5,862,105 1/1999 Nishimura .

**FOREIGN PATENT DOCUMENTS**

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8-17090 1/1996 (JP) .  
8-7383 1/1996 (JP) .

\* cited by examiner

Primary Examiner—Ali Neyzari

(74) Attorney, Agent, or Firm—Merchant & Gould PC

(57) **ABSTRACT**

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**2 Claims, 18 Drawing Sheets**

